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RAILWAY EXTENSION IN INDIA

WITH SPECIAL REFERENCE

TO THE

EXPORT OF WHEAT,

A PAPER READ BEFORE THE MEMBERS

OF THE SASSOON MECHANICS' INSTITUTE, BOMBAY,

BY

ARTHUR W. FORDE, MEMBER INST. C. E.,

PRESIDENT OF THE INSTITUTE.

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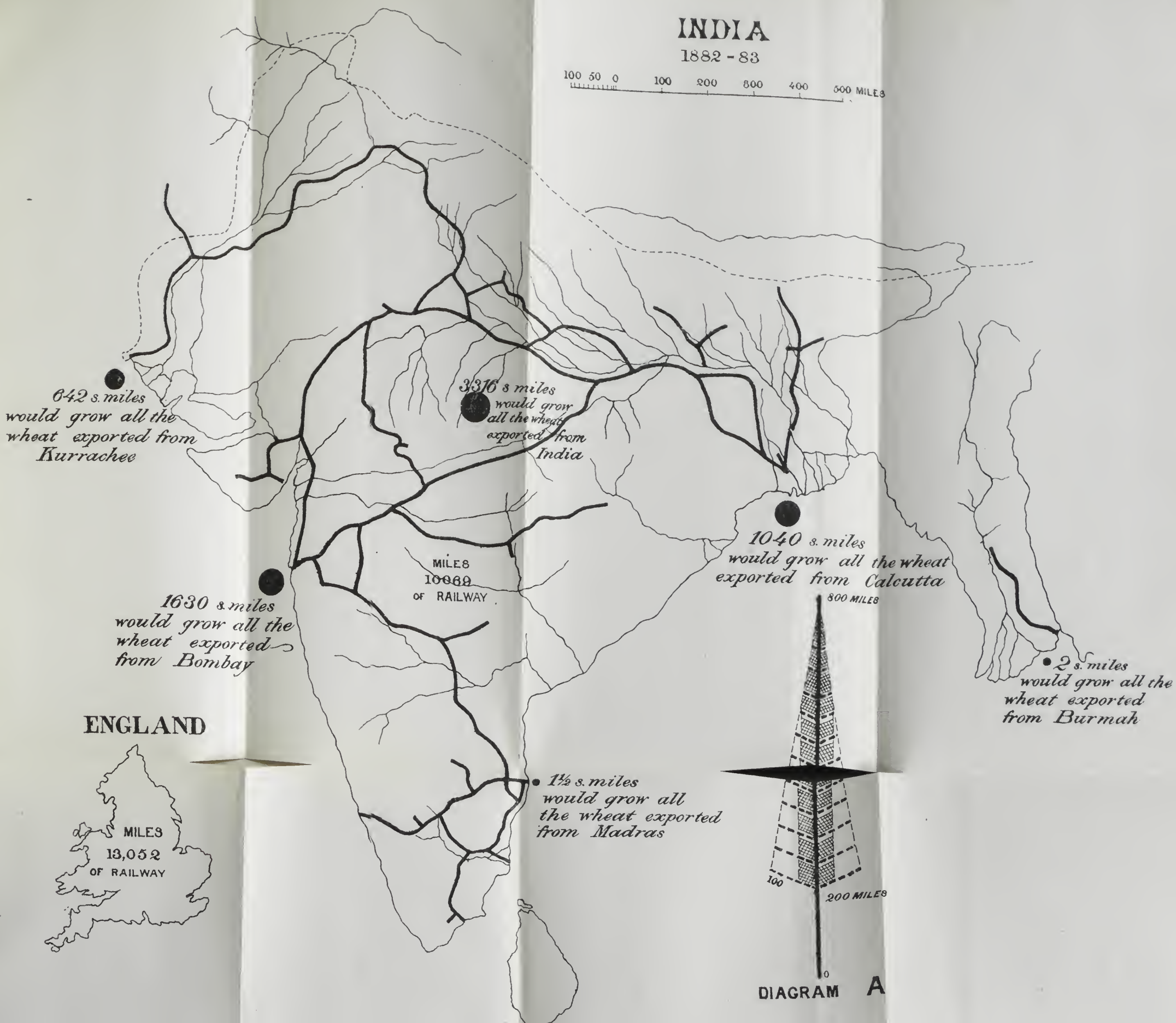
1884.

THE Chairmain, in opening the proceedings, said that Mr. Forde's lecture would be very interesting and of great value at this particular juncture, when every mail they received full reports of the evidence which was being given before the Parliamentary Committee on the subject of railway extension in India.

INDIA

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ENGLAND



RAILWAY EXTENSION IN INDIA

WITH

SPECIAL REFERENCE TO THE EXPORT OF W H E A T .



The subject may be divided into the following heads, viz :—

1st.—The mode of investigating the requirements of the country.

2nd.—The best method of ascertaining the traffic that may be expected.

3rd.—The cost of construction, working expenses and profits.

4th.—The nature of concession to be granted by Government and the question of guarantees.

5th.—The financial position of existing railways.

2. As regards the requirements of the country, the following extract from a report on Public Works in Madras, dated 1853, bears strongly on the subject.

“ To estimate the value of a line by the traffic on
“ it when it is in such a state as to throw every
“ possible impediment in the way of traffic is contrary to reason. The way to ascertain the really
“ most important lines is, by careful local inquiry,
“ aided by the study of the map ; and if the present
“ classification is tested in this way, it will be found
“ that we are treating some of the most important
“ lines as if they were of no more use than to join
“ neighbouring villages.”

This, of course, referred to roads, but is equally applicable to railways.

3. The question, therefore, is, what description of local enquiry and statistics is necessary, and how are they to be used. The first thing to be considered is, to what extent will the present railways form a basis for future extensions, or to what extent would it be advisable to supplement them with additional trunk lines. To make this part of the subject clearer, I have prepared a diagram on the map of India, marked **A**, on which the thick black line represents a main line of railway, and the dotted lines, roads. These roads may be at unequal distances; but in the present instance they are shown 50 miles apart, with a uniformity which I need scarcely say can never be carried out in practice, but which will answer our present purpose. The scale of the diagram is the same as that of the map.

4. We will now examine this question with special reference to the exportation of wheat or other grains, basing the investigation on the supposition that the price of wheat is such as will only leave a margin of Rs. 25 per ton for land carriage to the place of export. We will also assume that the rate of carriage by railway is six pias per ton per mile, and by road three annas. On this assumption, it will be evident, that wheat will bear only the charges on 800 miles of railway, or on 400 miles of railway and 66 miles of road, or on 200 miles of railway and 100 miles of road, with a margin of Rs. 25. These are the maximum distances it can be carried with the rates above named; but in practice the distance by road must be greatly reduced, as will be seen by taking as an example the longest road-distance given above, viz., 100 miles, and considering the means of transport. For this purpose a square mile may be taken with a population of 200 to the square mile, situated 100 miles from a railway station. The basis of this enquiry must be the number of draft cattle available, and a fair average for such a population may be taken at 15 pair

to a square mile. Taking a day's journey at 14 miles with one day's rest at each end, and a load on a country road of one-third of a ton, the 15 pair of bullocks could only deliver $9\frac{1}{3}$ tons at a station 100 miles distant in a month, or 28 tons in three months.

5. A population of 200 may be taken as consuming in food grains at the most the produce of 200 acres, out of the 640 acres contained in a square mile, and if we allow 140 acres for roads, village sites and waste, there remains 300 acres available for growing crops for export, which would yield 100 tons; while the entire carrying power, as shewn above, is only 28 tons, if constantly employed for 3 months. We may therefore, conclude that the influence of the railway extend only about 30 miles on each side except for valuable produce such as opium, tobacco, sugar, cotton, &c.; and observation confirms this result.

Diagram A shews the area of country practically served by a main line with country roads as feeders to the railway as regards wheat and food-grains, under the above conditions. We may conclude therefore that lines of railway, sixty miles apart, will not interfere with each other, and that a very small area of this country is served by existing railways, and a very small percentage of the area of India is in a position to export surplus produce, such as wheat or food-grains.

6. If this be taken as a basis for investigating the wants of the country, it will be necessary to modify it according to circumstances, as a range of hills or a large river parallel to the course of a railway would still further limit the area served; and again in an isolated wheat district at a greater distance than 30 miles from a railway the cultivators might be specially circumstanced as to carriage and be able to take their entire surplus produce to the railway.

The most advantageous system of railways for this country would be lines from the interior to the coast for export produce,

as also for periods of famine, as it would give the smallest amount of land carriage with cheap water carriage to any commercial centre. As examples in the Bombay Presidency, a line from Ratnagiri to some point between Kolapore and Satara and one from Surat up the Taptee Valley would not interfere with other lines, and would be a great benefit to those districts. In the Taptee Valley there is a wheat district near Nundurbar that produces a specially good class of wheat, and is about 90 miles from Surat. The Nurbadda Valley might also be advantageously tapped from Baroda, as well as the Kupperwunj and Edur districts from Neriad or Ahmedabad, or both.

7. We will now consider the 2nd head, or the best method of ascertaining the traffic that may be expected. What is principally wanted to judge of this is, statistics of population, of the area cultivated, the area fit for cultivation, and waste land. These can be obtained from all collectorates and from each village and talooka separately; and one of the first efforts of the Indian Governments should be the preparation of maps, similar to those issued by the Irish Railway Commission, with their report published in 1838. The most important one shewed at a glance the comparative density of population, the most dense being the darkest shade, with figures at places, shewing the number per square mile. A map similarly prepared, shewing the number of draft cattle per square mile, would also be valuable. With such a map of the population, and the experience we now have of railways, data might be established, from which prospective traffic might be estimated with some certainty.

Sir C. Trevelyan, soon after the Madras Railway was opened, wrote on this subject, and came to the conclusion, that 67 out of every 1000 of population travelled one mile daily, and he took a width of 25 miles, or $12\frac{1}{2}$ miles on each side of the railway as being influenced. Since then, however, experience has shown this to be much too low, and it would be nearer the mark to allow 100 instead of 67 in the above estimate; but statistics of present railways would be

a safe guide, taking districts as similar as possible to base the estimates on ; exceptional lines would be those to places of pilgrimage, where the passenger traffic is excessive at certain periods.

8. If population be taken as a guide, the area of country influenced must be carefully considered. On a main line $12\frac{1}{2}$ miles on either side, except where ghats or a large river contracts it, may be the basis of calculation. And as regards goods, the staple produce of the country must be considered and the probability of extended cultivation, consequent on the increased facilities for export. On a branch line, the main line divides the traffic for a certain distance from the junction, and the more the branch diverges from a right angle the greater will be the divided area.

Instance the Gaekwar of Baroda's lines, one of which branches off from Miagam Station on the B. B. & C. I. Railway, while the other branches off near Baroda, only 17 miles distant ; the two crossing each other at 20 miles from Miagam and 20 miles from Baroda, each being continued 10 miles beyond the point of crossing. The result is a very small traffic per mile as compared with other lines ; the area influenced is divided, and the traffic in passengers per mile is only about one-fourth that on the main line : but notwithstanding this and a goods traffic of only 36 tons a mile a day, the line is a financial success. What is wanted therefore to estimate expected traffic, is statistics of the working of railways specially arranged for the purpose, and statistics of population, draft cattle and cultivation, also specially arranged.

9. The third division of the subject is cost of construction, working expenses, and profits, and as past experience is the best guide, a number of diagrams have been prepared from the figures given in Col. Hancock's Administration Report on Railways in India for 1882-83. They are as follows—

Diagram No. I.—The age of the different railways.

„	II.	The length	„	„
„	III.	The average cost per mile	„	„

Diagram No. IV.—The earnings per mile per week.

- | | | | | |
|---|-------|--|-----|-----|
| „ | V. | Working expenses | do. | do. |
| „ | VI. | Profits per | do. | do. |
| „ | VII. | Financial results. | | |
| „ | VIII. | Average daily traffic per mile. | | |
| „ | IX. | Average load in each train. | | |
| „ | X. | Passenger rates per mile, showing also
the cost of carrying a passenger a mile,
and the profits per passenger per mile. | | |
| „ | XI. | Goods rates, shewing also cost and profits
per ton per mile. | | |
| „ | XII. | Dead weight per passenger and per ton
of passenger freight and per ton of
goods. | | |
| „ | XIII. | Average speed of passenger, goods, and
mixed trains per mile per hour. | | |
| „ | XIV. | Percentage of receipts from passengers
goods, and sundries. | | |
| „ | XV. | Average length of line open each year
with receipt, per mile per week at corresponding
dates, for some of the lines
only. | | |

10. The following explanation will show the application of these diagrams to this part of the subject, the first 13 railways being broad gauge, the next ten metre gauge, and the last the Gaekwar's line of 2 feet 6 in. gauge. In some of them there are blanks, as the statistics do not give the necessary information.

Diagram I is necessary to form an accurate judgment as to traffic which requires some years to develop fully, as will be seen on referring to Diagram XV.

Diagram II shews the lengths of the lines—an important element in judging of traffic, as the fixed expenses, which are not affected by the amount of traffic, are divided over a greater

mileage on the longer lines. On this Diagram the longest lines shew the total of main line and branches, and the thicker lines shew the main line and branches separately, and the greatest length of line worked in one continuous length. For instance, the Madras Railway, though 858 miles long, has for its longest continuous length for working only 400 miles, while the B. B. and C. I. Railway with a total length of 461 miles has a continuous length for working of 390 miles.

Diagram III shewing the cost of construction is a most important one, and when taken in connection with Diagrams IV, V, VI, and VII, forms the key to the subject of railway extension, as regards its financial aspect, No. IV. shewing the earnings; No. V. the expenses; VI. the profits per mile per week, and No. VII. the percentage on capital each line pays. Beginning with Diagram IV, the half-years are shown separately.

Diagram VIII, when taken in connection with Nos. III and VII, will help to solve the following question—What should a railway cost to yield 4 per cent, with a certain number of passengers and tons of goods daily traffic?

Diagram IX shews the average number of passengers in each passenger train, and the number of tons of goods in each goods train. The average number of passengers in a train varies little, the gauge seeming to make no difference; and the number of tons of goods in a train is most, where the traffic is greatest. On lines with less than 200 tons carried over the line daily, it is evident that with only one train each way daily the average load could not exceed 100 tons.

Diagram X shews to what extent different lines vary as to the average charge for passengers; also that the cost of carrying a passenger one mile differs little except in some glaring exceptions, and the profit per passenger depends chiefly on the rate charged. A column is inserted at the end of this table, shewing the cost of fuel per passenger per mile, and it will be seen that, with the exception of the East Indian Railway, where the

cost of fuel is scarcely perceptible, and the Punjab Northern, which is furthest from the coal-supply, it varies little, and averages about one-quarter pie per passenger.

Diagram XI shews the average charge per ton of goods per mile, which varies considerably even on the same line in the two half-years. The cost of carrying, as a rule, varies with the quantity of traffic, and the profits are most variable, both in the different lines and the different half-years of the same line. The cost of fuel per ton per mile of goods is also given, and the remarks on fuel in connection with Diagram X apply equally to this.

Diagram XII shews that the dead weight carried with each passenger, averages from three-quarters to one ton on the broad gauge, and about half a ton per passenger on the metre gauge. That the dead weight per ton of freight in passenger trains averages about 11 tons on the broad gauge and eight tons on the metre gauge. As regards goods, there is little difference, the average of all being about 2 tons of dead weight to 1 ton of freight, except on the East Indian Railway, where the coal trade gives a return load and reduces the number of empties.

Diagram XIII shewing the speed of trains, speaks for itself, and as regards goods trains shows little variation.

Diagram XIV. shews the comparative amounts received on each line for passengers, goods, and sundries, and at the bottom of this Diagram is given the average for all the lines for both the half-years and the year, from which it will be seen that $30\frac{1}{2}$ per cent of receipts is for passengers, $66\frac{1}{3}$ per cent for goods and $3\frac{1}{2}$ per cent for sundries. The number of passengers and tons booked is no guide, for besides the fact that passengers travel, on an average only 60 miles, and each ton of goods 160 miles, the average rate per passenger is only $2\frac{1}{2}$ pies and goods 9 pies per mile, whereas in other countries with which I have seen this compared, passengers and goods average about the same rate per unit per mile. It is therefore erroneous to suppose, that because 5 or 6 passengers are booked to 1 ton of, goods in India, compared with half that number of passengers

per ton of goods in England, that therefore the receipts for passengers is greatest in India ; for, as shown by the Diagram drawn from facts, the receipts for goods on Indian railways are double the receipts for passengers. The actual number of passengers booked on the lines under review was 58,875,918, and tons of goods 14,833,243 ; while the receipts were for passengers Rs. 4,64,40,855, for goods Rs. 10,15,96,738.

Diagram XV shows the length of eleven of the Indian railways open for traffic each year from their commencement to the present time, and for each corresponding year the receipts per mile per week. The East Indian shews many ups and downs. On the opening of a long length, it will be seen that the average mileage receipts were usually reduced, consequent on the new piece having had no traffic previously developed. They almost all shew a steady annual increase when a line is completed, the most remarkable being the Eastern Bengal, and a rather prominent exception to this rule is the Madras Railway except for one year which I presume was the famine year.

11. The question : What should a railway cost to yield 4 per cent with a certain number of passengers and tons of goods passing over each mile daily in both directions may now be investigated. It may be taken for granted that 3 pies per mile for a passenger and an average of 9 pies per ton per mile for goods can be levied on any new line, and this will be taken as the basis for the following calculation. The first thing to decide on is the total receipts, and the following table shews this approximately.

TABLE No. 1.

A line costing

Rs. 2,00,000 per mile, requires a traffic of Rs. 350 per mile per week

Do.	„	1,50,000	„	„	„	250	„	„
Do.	„	1,00,000	„	„	„	200	„	„
Do.	„	75,000	„	„	„	150	„	„
Do.	„	50,000	„	„	„	110	„	„
Do.	„	40,000	„	„	„	80	„	„
Do.	„	30,000	„	„	„	65	„	„
Do.	„	20,000	„	„	„	45	„	„

12. This has now to be divided into certain proportions of passengers and goods, and Diagram VIII shews how variable they are ; the number of ton miles of goods on the East Indian line and the G. I. P. being greater than the unit mileage of passengers ; while on the Madras line the number of passengers is nearly three times the number of tons of goods, and on other lines, recently opened, the proportions are from 4 and 6 to 1. The following table shews the daily number of passengers and tons of goods required to yield the receipts given in Table No. 1.

TABLE No 2.
Passengers and Goods daily.

Receipt per Mile per week.	Daily Number of Passengers and Tons of Goods.									
	1 passenger to 1 ton of goods.	2 passengers to 1 ton of goods.	3 passengers to 1 ton of goods.	4 passengers to 1 ton of goods.	5 passengers to 1 ton of goods.					
Rs.	Passr. No.	Goods Tons.	Passr. No.	Goods Tons.	Passr. No.	Goods Tons.	Passr. No.	Goods Tons.	Passr. No.	Goods Tons.
350	798	798	1277	637	1600	532	1828	457	1998	400
250	570	570	912	455	1142	380	1306	326	1427	285
200	456	456	730	364	914	304	1025	261	1142	228
150	342	342	547	273	685	228	783	196	856	171
110	250	250	401	200	502	167	574	143	628	125
80	182	182	292	145	365	121	417	104	457	91
65	148	148	237	118	297	99	339	85	371	74
45	102	102	164	82	205	68	235	59	257	51

13. The above are, of course, approximate estimates, but are pretty closely borne out by present statistics. To apply these, we will suppose a district with a population of 250 per square mile, and the average width judged to be influenced ten miles on each side and, say, 3 passengers for each ton of goods. Then $20 \text{ square miles} \times 250 = 5000$ inhabitants influenced per mile of railway ; and if we suppose 100 travel one mile daily out of each 1000, this will give a daily traffic of 500 passengers over each mile and 166 tons of goods.

The weekly income per mile would be as follows :—

	Rs.	a.	p.
500 passengers × 7 days @ 3 pies per passenger	...	54	11-0
167 tons of goods × 7 days @ 9 pies per ton	54	11-0

Total per mile per week Rs. 109-6-0

This is the same as the 5th example in the above table, and shows that the cost of the railway must not exceed Rs. 50,000 a mile, to pay 4 per cent per annum on the capital expended. Similarly calculated, a district with a population of 380 to a square mile, a width of 12 miles on each side influenced, and an expected goods traffic of 1 ton to 2 passengers, the daily traffic would be 912 passengers and 455 tons of goods; and on looking at the above tables, the second example shews that this traffic would yield 4 per cent interest on an expenditure of Rs. 1,50,000 per mile. With a line like the Gnicowar's with 250 inhabitants per square mile, and only 5 miles influenced each side, the calculation will shew that with one ton of goods to 4 passengers the receipts would only warrant an expenditure of Rs. 23,000 a mile, as they would be only Rs. 48 per mile per week. This is based on only one year's working, but shows how to utilize statistics.

14. This shews clearly that, if money is an object, and future railways are to be self-supporting, the above is the only way of dealing with the subject, and if so dealt with, they must as a whole be self-supporting, and instead of being a tax on the country, must develop its resources and increase its prosperity year by year.

15. As regards the above examples, there is no difficulty in deciding that the second example would, under ordinary circumstances, admit of a broad gauge line being constructed; that, except in an easy country, the first example would only admit of the construction of a metre gauge line, and the last example would only admit of a line being constructed of 2 ft. 6 inch gauge. According to the statistics of lines already com-

pleted, it would seem as if a metre gauge was half the cost of a wide gauge line, and a 2 ft. 6 in. gauge half the cost of the metre gauge. This opinion is based on Diagram No. III ; but when surveys are being made, it adds little to the cost of preparing the estimates to calculate the cost of both gauges. My own opinion is, after careful observation, that the metre gauge costs about 40 per cent less than the wide gauge, and the 2ft. 6 in. gauge 40 per cent less than the metre gauge. For instance, that where a wide gauge line would cost Rs. 1,00,000 (one lac) per mile, a metre gauge would cost Rs. 60,000, and a 2ft. 6 in. line Rs. 36,000 a mile. And where a broad gauge line would cost Rs. 60,000, a metre gauge would cost Rs 36,000, and a 2ft 6 in. gauge Rs. 21,600 a mile.

16. The second part of the third head of this subject is working expenses, and this is clearly shown on Diagram V for both half-years separately, and there is one peculiarity as regards the two half-years, viz that, although the earnings per mile per week on some lines vary as much as 40 per cent, the expenses in no cases are increased beyond about 12 per cent. and on lines of equal traffic, the gauge makes little or no difference ; but that on the whole the metre gauge lines are the most economical as regards passengers. This is shewn more particularly in Diagram X, in the 2nd column, which gives the cost of carrying a passenger a mile. On lines of equal traffic, it is least on narrow gauge lines. Diagram XI shews that the cost of carrying a ton of goods one mile is also slightly in favour of the narrow gauge on lines of equal traffic. These Diagrams also shew that the variation in the rates received makes any calculation based on percentage of receipts fallacious as regards enabling any one to form a judgment as to the economy or otherwise of working, for the average rates received for the carriage of goods on the different lines varies from 6 to 12 pies per ton per mile. The causes of this are various, and sometimes arise entirely from the products of the country being principally of a valuable kind that will bear high rates. On some lines, as will be seen, goods are carried at a loss during one half-year,

and on other lines passengers are worked at a loss during one half-year.

17. Another matter frequently alluded to is, the amount of dead weight, and as a good deal of ignorance prevails on this matter, Diagram XII will correct it. As previously remarked, there is considerable advantage on the side of the narrow gauge.

18. These comparisons as to the working of the different gauges are made, to shew that on financial grounds, as regards working expenses, there is no objection to the metre gauge, and as regards the 2 ft. 6 in. gauge the following quotation from a report of Mr. Mathew, the Agent and Chief Engineer of the B. B. & C. I. Railway, who was a persistent advocate of the wide gauge, will be interesting. It was with reference to a branch line to Kupperwunj, and is as follows :—

“The construction of a line on the scale of the lines now under construction for the Gackwar need not cost more than Rs. 23,000 a mile, being Rs. 18,000 per mile for way and works, and Rs. 5,000 for rolling stock, or a sum of 4 lakhs and sixty thousand Rupees for the 20 miles. I was a few days ago over the new piece of the line from Dubhoi to Chandode, 10 miles, which will be ready for opening within three weeks. It is a well-constructed piece of line of the two feet six inch gauge, well ballasted, with thirty pound steel rails on good teak sleepers, made on a new location on which there was no road before. The whole cost, including station and staff quarters will be under twenty thousand rupees a mile. The engines on the road take twenty loaded vehicles, each containing three tons at a rate of about eight miles an hour. For the particular length, it seems to be at present suitable. The whole 38 miles under construction by this Company for the Gackwar will probably be finished within the next three months, and it is probable that the system may soon attain a wider extension. A similar system would, to some extent, meet the requirements for traffic between Dakor and Kupperwunj, and some further extensions on particular districts.”

19. The fourth division of the subject may now be considered, viz., The nature of concessions to be granted by Government, and guarantees.

20. So long as the present system continues, there seems to be little prospect of railways increasing to meet the growing wants of the country. What is chiefly wanted to enlist private capitalists is (1) reliable information as to expected traffic, and (2) no more Government control than is necessary for the public safety. The land should also be granted free, and payment made for postal service; nor would it be too much to expect not only the use of a road (should there be one) but half the cost of its maintenance, should one-half be retained for ordinary road traffic. A road, if of any use as a feeder, is an annual expense, besides the cost of its construction being non-productive.

20. Reliable information as to traffic has been already treated of, and the question of Government control may now be considered both in the initiative stage and after completion. In the initiative stage Government are now all powerful; they have simply to say we don't approve of a particular line, and no one can gainsay them. As an instance of this, the Dakor and Kupperwunj line may be quoted which Government prefer to one from Neriad to Kupperwunj, presumably, because the former will somewhat add to the revenue of the State line from Anund to Dakor. If a comparison is made between the two routes, it will be found that the area influenced by the two lines contains, on the Neriad route, an average of 473 inhabitants per square mile, whereas on the Dakor route it is only 180 per square mile. It is therefore not likely that those who petitioned for the Neriad and Kupperwunj line would accept the alternative Dakor line for the investment of their capital. There is a road between Neriad and Kupperwunj, specially constructed and bridged for a light railway with easy curves and gradients, and I do not think it would be too much for Government to grant the use of this road and half the annual cost of its maintenance.

In 1861 the Supreme Government granted concessions much more favourable than the above.

21. Something approaching to the Parliamentary enquiry at Home is required here in the first instance. An enquiry as to estimates and traffic, such as will satisfy the public that the scheme is a sound one and worthy of public support. The difficulty here is the forming of a committee like the Home Parliamentary Committee, independent of Government. How far the scheme of self-government will aid in this, it is difficult to say; but with standing orders regulating the introduction of schemes, and the preparation of plans, a local enquiry before a Talooka Committee might be instituted and evidence taken of the principal merchants and sowcars as to the necessity for a railway. This and the formation of a committee independent of Government at the Presidency capital, are matters that require careful consideration to work out, and no doubt there would be some difficulty in doing so. Existing railway companies should have a *locus standi* to oppose, and also Government itself as owners of state railways; the committee finally deciding on the value of the evidence given, and whether the scheme is to proceed.

22. In the present state of affairs and until confidence in the system was established, it might be advisable to introduce a system of guarantee somewhat similar to that adopted, to a small extent, in Ireland, when railways were in their infancy, and doubt existed as to their paying in so poor a country. It was a four per cent Barony guarantee. It may not be known to some here that the counties in Ireland are divided into Baronies, somewhat similar in extent to Talookas here. The consent had to be obtained from the Baronies affected, and a cess levied to cover any deficit in the guarantee. The practical working of such a guarantee in this country would be as follows:— On a railway being proposed through a certain line of country, the area influenced would be ascertained and the

talooka committees would be called upon to report on the scheme and the advisability of taxing the area influenced for any deficit in a four per cent guarantee. For a main line with, say, 10 miles of country influenced on each side and estimated to cost Rs. 50,000 a mile, there should be no difficulty in estimating the traffic with sufficient accuracy as to leave little chance of any deficit, except perhaps 1 or 2 per cent for the first year or two. If we calculate 2 per cent on Rs. 50,000, it would amount to Rs. 1,000 per annum; and if levied on 20 square miles, or 12,800 acres, it would amount to little more than one anna an acre. For a branch railway influencing only 6 miles on each side, a 2 ft. 6 in. gauge, costing only Rs. 20,000 a mile, 2 per cent. would amount to only Rs. 400 per annum or a tax of 10 pies per acre on the area influenced. But, as before stated, with careful estimates of traffic, the talookas need seldom be called on to contribute, and investors would be certain of at least a 4 per cent dividend. With independent management and local traffic carefully fostered, they would no doubt reap a much larger profit, and such as would encourage the investment of native capital. This guarantee would be equivalent to a Government guarantee, and as regards the justice of so taxing the talookas there can be no doubt, as only those benefitting would be taxed, and with a certainty of increasing the value of their crops, in some cases to the extent of Rupees per acre, the remote chance of having to pay one anna per acre could hardly be considered a grievance. As regards Government, the indirect advantages railways confer are too manifest and can scarcely be calculated. The additional area cultivated and the saving to the cultivators in land carriage enabling them to largely increase their incomes and to pay the Government assessments with regularity, are some of the many gains to Government.

23. To induce native capitalists to invest their money in railways, there must be a larger profit than 4 per cent., and in cases where it could be shown that the traffic would yield 4 or 5 per cent. on the cost of a wide gauge line, they should be

allowed the option of choice of gauge, if it could be shown that a narrower gauge would suffice for that traffic and yield dividends of 6 to 8 per cent, except there were Imperial reasons against it, which the Imperial Exchequer must be prepared to meet.

24. The 5th and last division is the financial state of existing railways. From Diagram VII it will be seen that one line pays a little over 10 per cent, another rather more than 9 per cent, and a third rather more than 8 per cent; and these are the Eastern Bengal, the G. I. P., and the East Indian Railways which have had nearly 20 years to develop, (see Diagrams Nos. 1 & 15). The B. B. & C. I., the Patna and Gya, the Rajputana, the Rangoon and Irrawady, and the Northern Bengal, each pay between 5 and 6 per cent. They are all lines of less than 6 years' standing, except the B. B. & C. I. Railway, which is of 16 years' standing. The Sindh, Punjab and Delhi and the Bhownuggur and Gondal lines each pay about $4\frac{1}{2}$ per cent., the former being of 16 years' standing, and the latter not 2 years'. The Gackwar's 2 ft. 6 in. line and the Cawnpore and Furruckabad pay nearly 4 per cent. The Oude and Rohileund, the Nizam's, the South Indian and the Nagpore and Chattisghur 3 per cent; the three first being of 10 and 8 years' standing and the last only 2 years'. The Tirhoot, Muttra-Hatras and Mysore about $2\frac{3}{4}$ per cent, and the Madras line of 18 years' standing only $2\frac{1}{2}$ per cent, the Indus Valley and Kandahar 2 per cent, the Wurdha Coal $1\frac{1}{4}$ per cent; the Punjab Northern 1 per cent, and the Calcutta and South Eastern only just pays its expenses and is of 13 years' standing. On comparing these results with Diagrams Nos. III and IV, it will be seen how lines with small earnings yield a larger percentage than some lines with double their earnings: the reason, of course, being the difference in cost of construction. Diagram VII illustrates very clearly the remarks made by Mr. Maclean in his able paper on railways, that is, the difference of the earnings in the two half-years. The evil he complains of is solely with refe-

rence to the guaranteed lines, which I have marked in Diagram VII with an asterisk ; and as the guarantee is a 5 per cent one, the advantage to shareholders he alludes to could only accrue where the income of one half-year was under $2\frac{1}{2}$ per cent and of the other half over $2\frac{1}{2}$ per cent, when the shareholders would have the lower half-year made up to $2\frac{1}{2}$ per cent, and no deduction made in the higher half-year's receipts. In 1882-83, only the shareholders of the B. B. & C. I. Railway benefitted by this. No doubt, as he states, the East Indian Railway is made to contribute largely towards the losses on other lines, which does not appear to be fair to its own constituents, viz., the cultivators, who, although charged lower rates than on other lines, might have their rates reduced still lower.

25. This question of rate on the East Indian Railway has an important bearing on a subject which has occupied the attention of the Bombay Chamber of Commerce for some time past, viz., the revision of the Rajputana and B. B. & C. I. Railway rates, so as to enable Bombay to compete with Calcutta for the wheat trade of the Punjab ; but I do not think they are aware that the cost of carrying a ton of goods one mile on the East Indian Railway is only 2.42 pies, whereas on the B. B. & C. I. Railway it is 4.73 pies and on the Rajputana Railway 5.32 pies. An inspection of Diagram XI will shew that the latter two are not excessive when compared with any but the East Indian rates. It would therefore be ridiculous to keep up the East Indian rates to the disadvantage of the Punjab trade to give Bombay what is called fair play, and equally ridiculous to expect the B. B. & C. I. and Rajputana Railways to work at losing rates.

26. The policy therefore for Bombay is to develop districts as near to Bombay as possible by means of cheap branch lines, where the land carriage would be only one half that from the Punjab, and would give the merchants and cultivators larger profits.

Diagram A illustrates how small a portion of the country can export wheat, and to shew still more clearly how little is

exported, circles have been drawn on the map of India, near Calcutta, Bombay and Kurrachee, which represent the area that would have grown all the wheat exported from those places in 1882-83 as given in Col. Hancock's "Railway Administration Report". In Guzerat the rotation crop for cotton is wheat, and I presume it is the same elsewhere, that is, provided there is a place of export for wheat with cheap means of transport. Cotton will bear heavy transport charges, but wheat will not. Where the rotation crop cannot be grown, there is naturally a tendency to grow cotton too frequently, at too short intervals on the same ground, that is, every second year instead of every third, to the injury of the cotton staple. Again, it is much more to the advantage of the railways that wheat should be grown, there being 7 cwt. of grain from an acre and only 1 cwt. of cotton.

27. Another help might be given to branch railways by the main lines, to encourage their construction, that is, to reduce the rates on the main line but not on the through rate giving the advantage to the branch lines as a sort of subsidy. For instance, the B. B. & C. I. Railway realizes an average profit of 1.31 pies per passenger per mile, and 4.70 pies on each ton of goods, and they could easily forego a portion of these on all traffic brought on to their line by a branch and booked through, the through rate being charged in full, but the division made in favour of the branch lines.

28. The subject of gradients as affecting the working of the different lines has not been touched, on account of the difficulty of treating it without special information. The East Indian and B. B. and C. I. Railway, have no doubt great advantages with their level lines, and from what little information I possess of the Rajputana line, I believe that were it constructed on the broad gauge, the maximum train load on the B. B. and C. I. Railway would be double that on the Rajputana Railway

29. As regards break of gauge, it seems as if the subject has never been fully considered and worked out in this country. Instead of making the difficulty at junctions the subject of constant complaints, the greatest effort should be made to reduce its effects to a minimum. In one instance in America, when a junction of lines of different gauges took place, and the Companies amalgamated, they had estimates made (1st) of the cost of altering the gauge of the least important line, and (2nd,) the cost of erecting steam machinery at the junction to transfer the waggon bodies from one line to the other, the alteration of stock and the annual cost of working capitalized. The latter course was adopted as it was found the cheapest. If the Indian Government would give a liberal sum for the best design for a transfer station of the broad and metre gauges, there is no doubt that, as in America, arrangements could be devised to transfer a whole train of waggons from one gauge to the other in a very few minutes without breaking bulk.

30. With reference to local traffic, there does not seem to be the same trouble taken to develope it as is usual elsewhere.

If a branch line is worked by the Company to which the main line belongs, everything is sacrificed to the main line, trains being arranged to suit their trains totally irrespective of the local traffic of the district. Instance the Guekwar's branch lines where the trains are arranged to leave the termini at 6-30 A. M. and arrive at Baroda and Miagaum 10-30 and 10-35, leaving both those places for the return-journey at 11-15 and 11-30, giving no facilities for passengers staying even a few hours at Baroda or Miagaum and returning the same day. Passengers for Baroda must stay a day and night to transact any business, even if their village is only 10 miles distant. There should certainly be two trains each way daily to and from Baroda, leaving both ends at an early hour and returning in the afternoon, which would certainly add largely to the passenger traffic and very little to the expenses, though it might not add directly to the receipts of the main line; but on the principle that facilities for moving

about induce a taste for travel, we might very fairly infer that increased facilities to local traffic would eventually increase the traffic into the main line.

In Ireland, when railways were in their infancy, from 1840 to 1855, every effort was made to break up the traffic along the roads by carrying the loaded carts in some instances with the driver, and not charging for the cart or driver. To develop trade, free tickets were given to merchants to each market town on the market day, and stores were erected for grain and apportioned to the different merchants. Matters are, of course, different in India, but much may be done by carefully studying the wants of the districts. An instance occurred in Ireland in 1850, showing the ignorance that first prevailed on the subject of railway traffic, when a meeting of grand jurors was called to try and induce them to support a Barony guarantee. One of the first questions asked was, what number of passengers and tons of goods daily would pay 4 per cent (the rate of the guarantee asked for) the reply was 100 passengers and 100 tons of goods daily, on which statement one influential gentleman got up and stated that a one horse car sufficed then for the passenger traffic, a two horse car having been started and failed. And as to 100 tons of goods he said, go along the road and see if you even get 10 tons of goods daily. It ended in no guarantee being recommended, and as the railway company was an English company, capital was obtained, the line completed, and with the result that it paid 5 per cent the 2nd year. It required careful management, strict economy as to work, and a careful study of the wants and resources of the country. Every inducement was given to merchants and farmers to make use of the railway, and traffic not expected to take care of itself: carriers who brought a certain number of tons weekly to a station were given a bonus, and those who established public conveyances for passengers were authorised to issue through tickets, on which they received a percentage from the railway company. All this could only be done by a private company with a local

management, or a manager with full powers and special knowledge of the districts. It would be quite worth while to try the experiment on a line of moderate length, say 60 miles, such as that from Neriad to Kupperwunj and Ahmedabad to Kupperwunj, where there is a population of 473 and 477 per square mile respectively, though a limited area only would be affected.

At the conclusion of the reading of the paper, the Chairman said that Mr. Forde invited discussion on the subject of his lecture, and therefore, if any gentleman wished to make any observations, he was at liberty to do so.

Mr. M. Mowat said, that Mr. Forde had placed before them such an array of facts and figures, that it was impossible for them to discuss the whole question in the short time which was at their disposal that evening. The subject of broad and narrow gauge was one in which Mr. Mowat said he had taken a great deal of interest; he, as well as, he believed, some of those who were present there, was very much startled by some of the opinions advanced by the lecturer. He thought Mr. Forde had stated that, if the broad gauge cost a lakh of rupees per mile, the narrow gauge for the same distance would cost Rs. 60,000. Now he (Mr. Mowat) wished to know whether this was the correct proportion; because he had been under the impression that the difference in cost between lines constructed on the broad and the narrow gauge was something like Rs. 12,000 per mile, and not so much as Rs. 40,000.

Mr. Forde replied that the statistics show that the cost of a metre-gauge line varied from Rs. 36,000 to Rs. 82,000 per mile. He added that the cheapest broad-gauge line was the Patna-Gya Railway, and the next cheapest was the Oudh and Rohileund Railway.

Mr. Mowat said that, with all respect to Mr. Forde, he would say that his reply did not show the relative cost of a broad and a narrow-gauge line under similar conditions.

Mr. Forde said that, generally speaking, the difference between the cost of construction in regard to the broad and narrow-gauge lines was about the sum he had already mentioned. He further said that they could not be positive about the difference in regard to any particular line, unless they procured estimates for a broad as well as a narrow gauge, so far as that line was concerned. It was a pity to run down the narrow gauge, if it could be constructed so cheaply. Mr. Mowat asked if the Rajputana line, which cost about Rs. 60,000 a mile, had been constructed on the broad gauge, would it have cost 90,000 a mile? Mr. Forde said that Mr. Mathew's estimate for a broad-gauge line in those districts showed that it would have exceeded Rs. 90,000 per mile.

Mr. S. S. Solomon asked if it was the lecturer's opinion that for long distances, where there was a heavy traffic, the broad gauge was preferable; and that, on the other hand, for short distances and for places where the traffic was light, the narrow gauge was better.

Mr. Forde replied in the affirmative.

The Chairman, in closing the discussion, said, I do not know as much about this matter as some of the gentlemen around me do. The Parliamentary Committee, which is at present engaged in taking down evidence on the subject, has been appointed to ascertain what steps should be taken for the purpose of carrying on railways in India, and whether they should be constructed on the broad or the narrow gauge. I think with Mr. Forde that in cases of feeders and of short distances, where the traffic was not large, the narrow gauge is more advantageous. It seems to me very clear that in this country, although we have now had a very considerable experience of railways, and although the natives of this country appreciate railways apparently to a very large extent, we have not yet advanced so far as to suppose that we can get natives to put their capital in railways and start a company, unless the Government offered a guarantee in some shape or other. I think that

those who are interested in the development of railways in this country should try and come to some conclusion on the matter, and then push that conclusion to some practical result. They may induce the Government, if possible, to lay down railways through various districts, where the population was large and the cultivation extensive. At present the Government seem to have limited themselves to a very small annual expenditure in the construction of railways. But I think it would be for the good of the country if the amount could be considerably raised, either by Government, carrying out a more liberal policy, or the people investing their money in this concern. (Hear, hear). I think we must all join in offering our thanks to Mr. Forde for the great trouble he must have taken in preparing a number of statistics and in getting together so many facts from various quarters. (Applause). The lecture, in order to be of much greater use, deserves an attentive perusal during our leisure hours. (Hear, hear).

The vote of thanks having been cordially carried, the meeting separated.

